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# METHOD AND APPARATUS OF INTERPOSING VOLTAGE REFERENCE TRACES BETWEEN SIGNAL TRACES IN SEMICONDUCTOR DEVICES

## BACKGROUND OF THE INVENTION

[0001] Field of the Invention: The present invention relates generally to the reduction or elimination of "cross-talk" between semiconductor device signal traces by interposing a grounding element between the signal traces. More particularly, the present invention relates to interposing a grounding element between printed circuit board traces and vias to minimize or eliminate mutual coupling between signal conductors.

[0002] State of the Art: Cross-talk between two adjacent conductive signal traces is a result of electrostatic and electromagnetic coupling between the conductive traces. Electrostatic and electromagnetic coupling is related to the impedance of a signal trace such that as mutual coupling increases, impedance increases. Cross-talk between signal traces is undesirable because it may cause signal delays and interference with signals transmitted through the signal traces. The primary factors affecting cross-talk include the surface area of the signal trace directed to an adjacent signal trace, the distance between the signal traces and the dielectric constant ( $\epsilon_r$ ) of the material between the signal traces. Air has a dielectric constant of 1, while printed circuit board resin conventionally has a dielectric constant of between 3 and 4. In general, coupling and cross-talk between two adjacent conductive signal traces increases as the facing surface areas of the traces increase, as the dielectric constant of the material between the signal traces increases, and as the distance between the signal traces decreases.

[0003] With the continuous desire of manufacturing smaller semiconductor devices, the distances between signal traces have necessarily been reduced, and multiple-layer and specially fabricated semiconductor and printed circuit board materials have been used to compensate for the electromagnetic coupling caused by closer conductors. One approach to canceling the electromagnetic coupling of a bias source in an electronic device is disclosed in U.S. Patent 4,349,848 to Ishii et al. (issued September 14, 1982). Ishii et al. uses impedance cancellation methods to cancel mutual coupling between signal traces by placing bias currents having opposite phases in two separate signal traces running parallel to each other. In this way, the